

What is claimed is:

- 1) In a fuel cell comprising:
  - A) a polymer electrolyte membrane;
  - B) a fuel electrode or anode;
  - C) an oxidation electrode or cathode; and
  - D) appropriate conductors for the supply of electrical current to an electrical load,  
the improvement comprising the use of a porous, coal-based, carbon foam as either or both of said anode and said cathode.
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2) The fuel cell of claim 1 wherein said coal-based carbon foam is semi-crystalline, largely isotropic, produced from particulate coal of a small diameter and exhibits a density of between about 0.1 and about 0.8 g/cm<sup>3</sup> and a thermal conductivity of below about 1 W/m/°K.
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3) The fuel cell of claim 2 wherein said small diameter is less than about 1 mm.
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4) The fuel cell of claim 2 wherein said coal-based carbon foam has a compressive strength below about 6000 psi.

5                   **5) The fuel cell of claim 1 wherein said coal-based carbon foam is  
prepared from bituminous coal.**

10                  **6) The fuel cell of claim 4 wherein said bituminous coal has a swell  
index of between about 3 and about 5.**

15                  **7) The fuel cell of claim 4 wherein said bituminous coal has a  
Gieseler plasticity value above about 500DDPM.**

20                  **8) The fuel cell of claim 2 wherein coal-based carbon foam exhibits a  
pore size below about 2000 $\mu$ .**

**9) The fuel cell of claim 8 wherein said coal-based carbon foam  
exhibits a pore size below about 100 $\mu$ .**

**10) The fuel cell of claim 2 wherein said coal-based carbon foam has  
been graphitized at a temperature between about 1600°C and  
2600°C.**

**11) The fuel cell of claim 9 wherein said coal-based carbon foam has  
been graphitized at a temperature between about 1800°C and  
about 2200°C.**

12) The fuel cell of claim 9 wherein said coal-based carbon foam has  
been graphitized at a temperature of about 2200°C.

13) The fuel cell of claim 2 wherein said coal-based carbon foam is  
5 prepared by a process comprising the steps of:

- A) comminuting coal to a small particle size to form a ground coal;
- B) placing said ground coal in a mold;
- C) heating said ground coal in said mold under a non-10 oxidizing atmosphere to a temperature of between about 300° C and about 700° C and soaking at this temperature for a period of from about 10 minutes to about 12 hours to form an electrode preform;
- D) controllably cooling said electrode preform; and
- E) graphitizing said electrode preform at a temperature 15 between about 1600°C and 2400°C.

14) In an electrical cell for the generation or storage of electrical  
power through an electrochemical reaction and comprising:  
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- A) an anode;
- B) a cathode; and
- C) appropriate conductors for the supply of electrical current  
to an electrical load,

**the improvement comprising the use of a porous carbon foam as either or both of said anode and said cathode.**

15) The electrical cell of claim 13 wherein said porous carbon foam is coal-based.

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16) The electrical cell of claim 14 wherein said coal-based carbon foam is derived from a coal having a swell index of between about 3 and about 9.

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17) The electrical cell of claim 15 wherein said swell index is about 4.

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**18) The electrical cell of claim 14 wherein said carbon foam is derived from a coal having a Gieseler plasticity value above about 500 DDPM.**

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19) The electrical cell of claim 14 wherein said carbon foam semi-crystalline, largely isotropic, produced from particulate coal of a small diameter and exhibits a density of between about 0.1 and about 0.8 g/cm<sup>3</sup> and a thermal conductivity of below about 1 W/m/<sup>o</sup>K.

20) The electrical cell of claim 18 wherein said small diameter is less than about 1 mm.

5 21) The electrical cell of claim 18 wherein said carbon foam has a compressive strength below about 6000 psi.

10 22) The electrical cell of claim 14 wherein coal-based carbon foam exhibits a pore size below about 2000 $\mu$ .

15 23) The electrical cell of claim 21 wherein said coal-based carbon foam exhibits a pore size below about 100 $\mu$ .

24) The electrical cell of claim 14 wherein said coal-based carbon foam has been graphitized at a temperature between about 1600°C and 2600°C.

20 25) The electrical cell of claim 23 wherein said coal-based carbon foam has been graphitized at a temperature between about 1800°C and about 2200°C.

26) The electrical cell of claim 24 wherein said coal-based carbon foam has been graphitized at a temperature of about 2200°C.

27) The electrical cell of claim 14 wherein said carbon foam is prepared by a process comprising the steps of:

- F) comminuting coal to a small particle size to form a ground coal;
- 5 G) placing said ground coal in a mold;
- H) heating said ground coal in said mold under a non-oxidizing atmosphere to a temperature of between about 300° C and about 700° C and soaking at this temperature for a period of from about 10 minutes to about 12 hours to form an electrode preform;
- 10 I) controllably cooling said electrode preform; and
- J) graphitizing said electrode preform at a temperature between about 1600°C and 2400°C.

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